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(71) Applicant *(for all designated States except US)*: **ENVENTURE GLOBAL TECHNOLOGY** [US/US]; 16200 A Park Row, Houston, TX 77084 (US).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **COOK, Robert, Lance** [US/US]; 934 Caswell Court, Katy, TX 77450 (US).

(74) Agent: **MATTINGLY, Todd**; Haynes and Boone, LLP, Suite 4300, 1000 Louisiana St., Houston, TX 77002-5012 (US).

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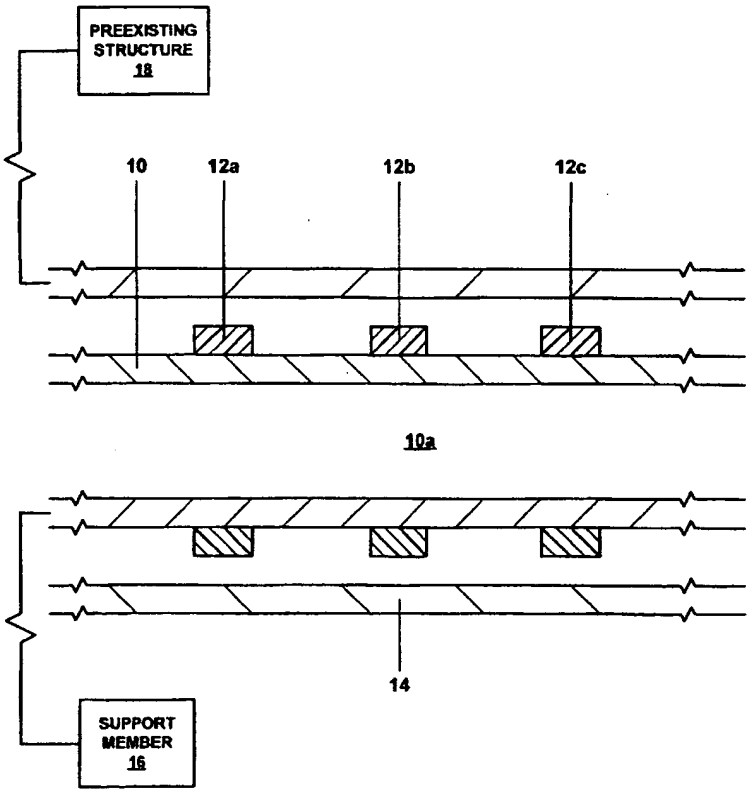
(54) Title: METHOD OF MANUFACTURING AN INSULATED PIPELINE

(57) Abstract: A method of manufacturing an insulated pipeline.



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INTERNATIONAL SEARCH REPORT

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PCT/US03/24779

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : F16L 55/16
US CL : 138/98, 97, 114, 148, 149 ; 29/421.2

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 138/98, 97, 114, 148, 149; 29/421.2, 421.1, 402.09, 890.036

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5,400,827 A (BARO et al) 28 March 1995 (28.03.1995), see entire document.	1-30
A	US 5,368,075 A (BARO et al) 29 November 1994 (29.11.1994), see entire document.	1-30
A	US 3,781,966 A (LIEBERMAN) 01 January 1974 (01.01.1974), see entire document.	1-30
A	US 4,505,017 A (SCHUKEI) 19 March 1985 (19.03.1985), see entire document.	1-30

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

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Name and mailing address of the ISA/US
Mail Stop PCT, Attn: ISA/US
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
Facsimile No. (703)305-3230

Authorized officer
Patrick F. Brinson
Telephone No. (703) 308-0861

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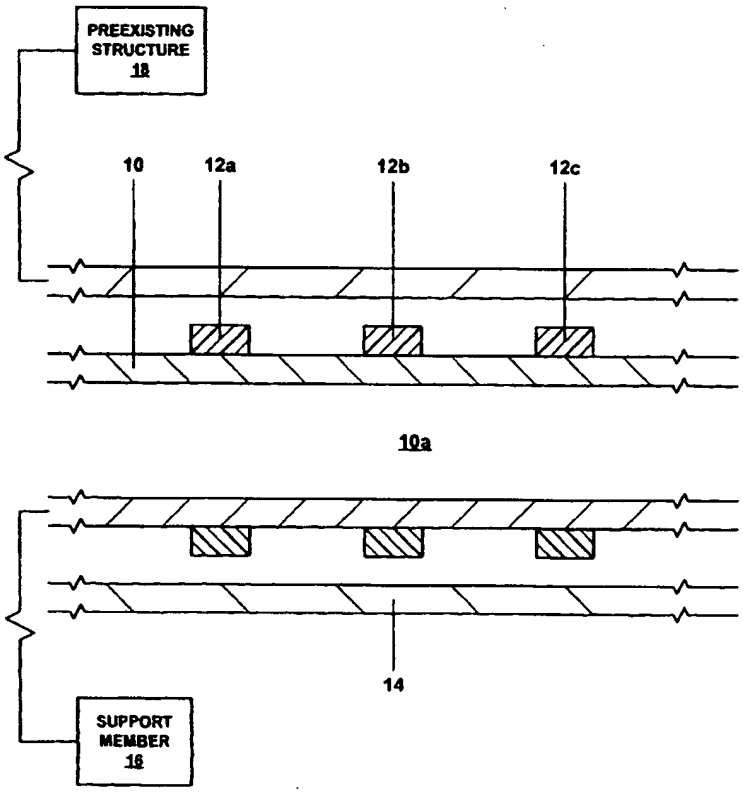
(57) Abstract: A method of manufacturing an insulated pipeline.



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AMENDED CLAIMS
[received by the International Bureau on 22 April 2004 (22.04.04) ;
New claims 31-51 have been added. (11 pages).]

1. A method of manufacturing an insulated pipeline, comprising:
positioning a first pipe having a plurality of spaced apart resilient sleeves coupled to the exterior surface of the first pipe within a second pipe; and
radially expanding and plastically deforming the first pipe until the resilient sleeves engage the interior surface of the second pipe.

2. The method of claim 1, further comprising:
injecting an insulating material into an annulus defined between the first and second pipes.

3. The method of claim 2, wherein injecting the insulating material into the annulus defined between the first and second pipes comprises:
injecting the insulating material into the annulus defined between the first and second pipes before radially expanding and plastically deforming the first pipe.

4. The method of claim 2, wherein injecting the insulating material into the annulus defined between the first and second pipes comprises:
injecting the insulating material into the annulus defined between the first and second pipes after radially expanding and plastically deforming the first pipe.

5. The method of claim 1, wherein the first pipe further comprises:
a plurality of thermal insulating sleeves coupled to the exterior surface of the first pipe and interleaved among the resilient sleeves.

6. The method of claim 1, wherein positioning the first pipe having the plurality of spaced apart resilient sleeves coupled to the exterior surface of the first pipe within the second pipe comprises:
positioning the second pipe beneath a body of water; and
positioning the first pipe having the plurality of spaced apart resilient sleeves coupled to the exterior surface of the first pipe within the second pipe.

7. A system for manufacturing an insulated pipeline, comprising:
means for positioning a first pipe having a plurality of spaced apart resilient sleeves coupled to the exterior surface of the first pipe within a second pipe; and

means for radially expanding and plastically deforming the first pipe until the resilient sleeves engage the interior surface of the second pipe.

8. The system of claim 7, further comprising:
means for injecting an insulating material into an annulus defined between the first and second pipes.

9. The system of claim 8, wherein means for injecting the insulating material into the annulus defined between the first and second pipes comprises:
means for injecting the insulating material into the annulus defined between the first and second pipes before radially expanding and plastically deforming the first pipe.

10. The system of claim 8, wherein means for injecting the insulating material into the annulus defined between the first and second pipes comprises:
means for injecting the insulating material into the annulus defined between the first and second pipes after radially expanding and plastically deforming the first pipe.

11. The system of claim 7, wherein the first pipe further comprises:
a plurality of thermal insulating sleeves coupled to the exterior surface of the first pipe and interleaved among the resilient sleeves.

12. The system of claim 7, wherein means for positioning the first pipe having the plurality of spaced apart resilient sleeves coupled to the exterior surface of the first pipe within the second pipe comprises:
means for positioning the second pipe beneath a body of water; and
means for positioning the first pipe having the plurality of spaced apart resilient sleeves coupled to the exterior surface of the first pipe within the second pipe.

13. A method of manufacturing an insulated pipeline comprising an inner rigid pipe positioned within, coupled to, and thermally insulated from an outer rigid pipe, comprising:
manufacturing the insulated pipeline by radially expanding and plastically deforming the inner rigid pipe within the outer rigid pipe.

14. The method of claim 13, further comprising:
positioning the outer rigid pipe at a location at which the insulated pipeline will be used to convey fluidic materials through the interior of the first pipe; and
manufacturing the insulated pipeline by radially expanding and plastically deforming the inner rigid pipe within the outer rigid pipe while the inner and outer rigid pipes are both positioned at the location at which

the insulated pipeline will be used to convey fluidic materials through the interior of the first pipe.

15. The method of claim 14, wherein the location at which the insulated pipeline will be used to convey fluidic materials through the interior of the first pipe is below a body of water.

16. A system for manufacturing an insulated pipeline comprising an inner rigid pipe positioned within, coupled to, and thermally insulated from an outer rigid pipe, comprising:
means for manufacturing the insulated pipeline by radially expanding and plastically deforming the inner rigid pipe within the outer rigid pipe.

17. The system of claim 16, further comprising:
means for positioning the outer rigid pipe at a location at which the insulated pipeline will be used to convey fluidic materials through the interior of the first pipe; and
means for manufacturing the insulated pipeline by radially expanding and plastically deforming the inner rigid pipe within the outer rigid pipe while the inner and outer rigid pipes are both positioned at the location at which the insulated pipeline will be used to convey fluidic materials through the interior of the first pipe.

18. The system of claim 17, wherein the location at which the insulated pipeline will be used to convey fluidic materials through the interior of the first pipe is below a body of water.

19. A thermally insulated pipeline, comprising:
a plastically deformed first pipe;
a plurality of spaced apart resilient sleeves coupled to the exterior of the first pipe; and
a second pipe coupled to the resilient sleeves.

20. The insulated pipeline of claim 19, further comprising:
thermal insulating material positioned within an annulus defined between the first and second pipes and interleaved among the resilient sleeves.

21. The insulated pipeline of claim 20, wherein one or more of the resilient sleeves include one or more longitudinal passages.

22. The insulated pipeline of claim 21, wherein at least some of the thermal insulating material is positioned within the longitudinal passages.

23. A method of operating a hydrocarbon production system for processing hydrocarbons that includes one or more hydrocarbon production sources and one or more hydrocarbon production destinations, comprising:
conveying hydrocarbons between the hydrocarbon production sources and the hydrocarbon destinations using one or more insulated pipelines; and
manufacturing at least one of the insulated pipelines by radially expanding and plastically deforming an inner rigid pipe within an outer rigid pipe.

24. The method of claim 23, further comprising:
positioning the outer rigid pipe at a location at which the at least one insulated pipeline will be used to convey fluidic materials through the interior of the first pipe; and
manufacturing the at least one insulated pipeline by radially expanding and plastically deforming the inner rigid pipe within the outer rigid pipe while the inner and outer rigid pipes are both positioned at the location at which the at least one insulated pipeline will be used to convey fluidic materials through the interior of the first pipe.

25. The method of claim 24, wherein the location at which the at least one insulated pipeline will be used to convey fluidic materials through the interior of the first pipe is below a body of water.

26. A method of manufacturing an insulated wellbore casing within a borehole that traverses a subterranean formation and includes a first wellbore casing coupled to and positioned within the wellbore, comprising:
positioning a second wellbore casing having a plurality of spaced apart resilient sleeves coupled to the exterior surface of the first pipe within the first wellbore casing; and
radially expanding and plastically deforming the second wellbore casing until the resilient sleeves engage the interior surface of the second pipe.

27. The method of claim 26, further comprising:
injecting an insulating material into an annulus defined between the first and second wellbore casings.

28. The method of claim 27, wherein injecting the insulating material into the annulus defined between the first and second wellbore casings comprises:
injecting the insulating material into the annulus defined between the first and second wellbore casings before radially expanding and plastically deforming the second wellbore casing.

29. The method of claim 27, wherein injecting the insulating material into the annulus defined

between the first and second wellbore casings comprises:
injecting the insulating material into the annulus defined between the first and second wellbore casings after radially expanding and plastically deforming the second wellbore casing.

30. The method of claim 26, wherein the second wellbore casing further comprises:
a plurality of thermal insulating sleeves coupled to the exterior surface of the second wellbore casing and interleaved among the resilient sleeves.

31. A method of manufacturing an insulated pipeline, comprising:
positioning a first pipe having a plurality of spaced apart resilient sleeves coupled to the exterior surface of the first pipe within a second pipe;
radially expanding and plastically deforming the first pipe until the resilient sleeves engage the interior surface of the second pipe; and
injecting an insulating material into the annulus defined between the first and second pipes before radially expanding and plastically deforming the first pipe.

32. A method of manufacturing an insulated pipeline, comprising:
positioning a first pipe having a plurality of spaced apart resilient sleeves coupled to the exterior surface of the first pipe within a second pipe;
radially expanding and plastically deforming the first pipe until the resilient sleeves engage the interior surface of the second pipe; and
injecting an insulating material into the annulus defined between the first and second pipes after radially expanding and plastically deforming the first pipe.

33. A method of manufacturing an insulated pipeline, comprising:
positioning a first pipe having a plurality of spaced apart resilient sleeves coupled to the exterior surface of the first pipe within a second pipe;
radially expanding and plastically deforming the first pipe until the resilient sleeves engage the interior surface of the second pipe; and
injecting an insulating material into the annulus defined between the first and second pipes before and after radially expanding and plastically deforming the first pipe.

34. A method of manufacturing an insulated pipeline, comprising:
positioning a first pipe having a plurality of spaced apart resilient sleeves coupled to the exterior surface of the first pipe within a second pipe; and
radially expanding and plastically deforming the first pipe until the resilient sleeves engage the interior

surface of the second pipe; and

injecting an insulating material into the annulus defined between the first and second pipes;

wherein the first pipe further comprises a plurality of thermal insulating sleeves coupled to the exterior surface of the first pipe and interleaved among the resilient sleeves.

35. A method of manufacturing an insulated pipeline, comprising:

positioning a first pipe beneath a body of water;

positioning a second pipe having the plurality of spaced apart resilient sleeves coupled to the exterior surface of the second pipe within the first pipe;

radially expanding and plastically deforming the second pipe until the resilient sleeves engage the interior surface of the first pipe; and

injecting an insulating material into the annulus defined between the first and second pipes;

wherein the second pipe further comprises a plurality of thermal insulating sleeves coupled to the exterior surface of the first pipe and interleaved among the resilient sleeves.

36. A system for manufacturing an insulated pipeline, comprising:

means for positioning a first pipe having a plurality of spaced apart resilient sleeves coupled to the exterior surface of the first pipe within a second pipe;

means for radially expanding and plastically deforming the first pipe until the resilient sleeves engage the interior surface of the second pipe; and

means for injecting an insulating material into the annulus defined between the first and second pipes before radially expanding and plastically deforming the first pipe.

37. A system for manufacturing an insulated pipeline, comprising:

means for positioning a first pipe having a plurality of spaced apart resilient sleeves coupled to the exterior surface of the first pipe within a second pipe;

means for radially expanding and plastically deforming the first pipe until the resilient sleeves engage the interior surface of the second pipe; and

means for injecting an insulating material into the annulus defined between the first and second pipes after radially expanding and plastically deforming the first pipe.

38. A system for manufacturing an insulated pipeline, comprising:

means for positioning a first pipe having a plurality of spaced apart resilient sleeves coupled to the exterior surface of the first pipe within a second pipe;

means for radially expanding and plastically deforming the first pipe until the resilient sleeves engage the interior surface of the second pipe; and

means for injecting an insulating material into the annulus defined between the first and second pipes before and after radially expanding and plastically deforming the first pipe.

39. A system for manufacturing an insulated pipeline, comprising:
means for positioning a first pipe having a plurality of spaced apart resilient sleeves coupled to the exterior surface of the first pipe within a second pipe;
means for radially expanding and plastically deforming the first pipe until the resilient sleeves engage the interior surface of the second pipe; and
means for injecting an insulating material into the annulus defined between the first and second pipes;
wherein the first pipe further comprises a plurality of thermal insulating sleeves coupled to the exterior surface of the first pipe and interleaved among the resilient sleeves.

40. A system for manufacturing an insulated pipeline, comprising:
means for positioning a first pipe beneath a body of water;
means for positioning a second pipe having the plurality of spaced apart resilient sleeves coupled to the exterior surface of the second pipe within the first pipe;
means for radially expanding and plastically deforming the second pipe until the resilient sleeves engage the interior surface of the first pipe; and
means for injecting an insulating material into the annulus defined between the first and second pipes;
wherein the second pipe further comprises a plurality of thermal insulating sleeves coupled to the exterior surface of the first pipe and interleaved among the resilient sleeves.

41. A method of manufacturing an insulated pipeline comprising an inner rigid pipe positioned within, coupled to, and thermally insulated from an outer rigid pipe, comprising:
manufacturing the insulated pipeline by radially expanding and plastically deforming the inner rigid pipe within the outer rigid pipe;
positioning the outer rigid pipe at a location at which the insulated pipeline will be used to convey fluidic materials through the interior of the first pipe; and
manufacturing the insulated pipeline by radially expanding and plastically deforming the inner rigid pipe within the outer rigid pipe while the inner and outer rigid pipes are both positioned at the location at which the insulated pipeline will be used to convey fluidic materials through the interior of the first pipe;
wherein the location at which the insulated pipeline will be used to convey fluidic materials through the interior of the first pipe is below a body of water.

42. A system for manufacturing an insulated pipeline comprising an inner rigid pipe positioned within, coupled to, and thermally insulated from an outer rigid pipe, comprising:

means for manufacturing the insulated pipeline by radially expanding and plastically deforming the inner rigid pipe within the outer rigid pipe;

means for positioning the outer rigid pipe at a location at which the insulated pipeline will be used to convey fluidic materials through the interior of the first pipe; and

means for manufacturing the insulated pipeline by radially expanding and plastically deforming the inner rigid pipe within the outer rigid pipe while the inner and outer rigid pipes are both positioned at the location at which the insulated pipeline will be used to convey fluidic materials through the interior of the first pipe;

wherein the location at which the insulated pipeline will be used to convey fluidic materials through the interior of the first pipe is below a body of water.

43. A thermally insulated pipeline, comprising:

a plastically deformed first pipe;

a plurality of spaced apart resilient sleeves coupled to the exterior of the first pipe;

a second pipe coupled to the resilient sleeves; and

thermal insulating material positioned within an annulus defined between the first and second pipes and interleaved among the resilient sleeves;

wherein one or more of the resilient sleeves include one or more longitudinal passages; and

wherein at least some of the thermal insulating material is positioned within the longitudinal passages.

44. A method of operating a hydrocarbon production system for processing hydrocarbons that includes one or more hydrocarbon production sources and one or more hydrocarbon production destinations, comprising:

conveying hydrocarbons between the hydrocarbon production sources and the hydrocarbon destinations using one or more insulated pipelines;

manufacturing at least one of the insulated pipelines by radially expanding and plastically deforming an inner rigid pipe within an outer rigid pipe;

positioning the outer rigid pipe at a location at which the at least one insulated pipeline will be used to convey fluidic materials through the interior of the first pipe; and

manufacturing the at least one insulated pipeline by radially expanding and plastically deforming the inner rigid pipe within the outer rigid pipe while the inner and outer rigid pipes are both positioned at the location at which the at least one insulated pipeline will be used to convey fluidic materials through the interior of the first pipe;

wherein the location at which the at least one insulated pipeline will be used to convey fluidic materials through the interior of the first pipe is below a body of water.

45. A method of manufacturing an insulated wellbore casing within a borehole that traverses a subterranean formation and includes a first wellbore casing coupled to and positioned within the wellbore, comprising:
positioning a second wellbore casing having a plurality of spaced apart resilient sleeves coupled to the exterior surface of the first pipe within the first wellbore casing;
radially expanding and plastically deforming the second wellbore casing until the resilient sleeves engage the interior surface of the second pipe; and
injecting the insulating material into the annulus defined between the first and second wellbore casings before radially expanding and plastically deforming the second wellbore casing.

46. A method of manufacturing an insulated wellbore casing within a borehole that traverses a subterranean formation and includes a first wellbore casing coupled to and positioned within the wellbore, comprising:
positioning a second wellbore casing having a plurality of spaced apart resilient sleeves coupled to the exterior surface of the first pipe within the first wellbore casing;
radially expanding and plastically deforming the second wellbore casing until the resilient sleeves engage the interior surface of the second pipe; and
injecting the insulating material into the annulus defined between the first and second wellbore casings after radially expanding and plastically deforming the second wellbore casing.

47. A method of manufacturing an insulated wellbore casing within a borehole that traverses a subterranean formation and includes a first wellbore casing coupled to and positioned within the wellbore, comprising:
positioning a second wellbore casing having a plurality of spaced apart resilient sleeves coupled to the exterior surface of the first pipe within the first wellbore casing;
radially expanding and plastically deforming the second wellbore casing until the resilient sleeves engage the interior surface of the second pipe; and
injecting the insulating material into the annulus defined between the first and second wellbore casings after radially expanding and plastically deforming the second wellbore casing;
wherein the second wellbore casing further comprises a plurality of thermal insulating sleeves coupled to the exterior surface of the second wellbore casing and interleaved among the resilient sleeves.

48. An hydrocarbon production system for processing hydrocarbons that includes one or more hydrocarbon production sources and one or more hydrocarbon production destinations, comprising:
means for conveying hydrocarbons between the hydrocarbon production sources and the hydrocarbon destinations using one or more insulated pipelines;

means for manufacturing at least one of the insulated pipelines by radially expanding and plastically deforming an inner rigid pipe within an outer rigid pipe;
means for positioning the outer rigid pipe at a location at which the at least one insulated pipeline will be used to convey fluidic materials through the interior of the first pipe; and
means for manufacturing the at least one insulated pipeline by radially expanding and plastically deforming the inner rigid pipe within the outer rigid pipe while the inner and outer rigid pipes are both positioned at the location at which the at least one insulated pipeline will be used to convey fluidic materials through the interior of the first pipe;
wherein the location at which the at least one insulated pipeline will be used to convey fluidic materials through the interior of the first pipe is below a body of water.

49. A system for manufacturing an insulated wellbore casing within a borehole that traverses a subterranean formation and includes a first wellbore casing coupled to and positioned within the wellbore, comprising:
means for positioning a second wellbore casing having a plurality of spaced apart resilient sleeves coupled to the exterior surface of the first pipe within the first wellbore casing;
means for radially expanding and plastically deforming the second wellbore casing until the resilient sleeves engage the interior surface of the second pipe; and
means for injecting the insulating material into the annulus defined between the first and second wellbore casings before radially expanding and plastically deforming the second wellbore casing.

50. A system for manufacturing an insulated wellbore casing within a borehole that traverses a subterranean formation and includes a first wellbore casing coupled to and positioned within the wellbore, comprising:
means for positioning a second wellbore casing having a plurality of spaced apart resilient sleeves coupled to the exterior surface of the first pipe within the first wellbore casing;
means for radially expanding and plastically deforming the second wellbore casing until the resilient sleeves engage the interior surface of the second pipe; and
means for injecting the insulating material into the annulus defined between the first and second wellbore casings after radially expanding and plastically deforming the second wellbore casing.

51. A system for manufacturing an insulated wellbore casing within a borehole that traverses a subterranean formation and includes a first wellbore casing coupled to and positioned within the wellbore, comprising:
means for positioning a second wellbore casing having a plurality of spaced apart resilient sleeves coupled to the exterior surface of the first pipe within the first wellbore casing;

means for radially expanding and plastically deforming the second wellbore casing until the resilient sleeves engage the interior surface of the second pipe; and

means for injecting the insulating material into the annulus defined between the first and second wellbore casings after radially expanding and plastically deforming the second wellbore casing;

wherein the second wellbore casing further comprises a plurality of thermal insulating sleeves coupled to the exterior surface of the second wellbore casing and interleaved among the resilient sleeves.